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(71) Applicant: **Accelerix Limited**  
**Jersey, Channel Islands, JE2 4WD (GB)**

(72) Inventors:  
• **Fielder, Dennis**  
**Cambridge CB1 6LS (GB)**  
• **Derbyshire, James**  
**Cambridge CB4 5LB (GB)**

• **Gillingham, Peter**  
**Ontario, K2K 2K9 (CA)**  
• **Torrance, Randy**  
**Ottawa, Ontario, K1Y 4T4 (CA)**  
• **O'Connell, Cormac**  
**Ontario, K2K 1B6 (CA)**

(74) Representative: **Weber, Dieter, Dr. et al**  
**Weber, Dieter, Dr.,**  
**Seiffert, Klaus, Dipl.-Phys.,**  
**Lieke, Winfried, Dr.**  
**Postfach 61 45**  
**65051 Wiesbaden (DE)**

**(54) Single chip frame buffer and graphics accelerator**

(57) A single chip display processor comprised of a dynamic random access memory (DRAM) for storing at least one of graphics and video pixel data, a pixel data unit (PDU) for processing the pixel data, integrated in the same integrated circuit (IC) chip as the DRAM, the IC chip further comprising a massively parallel bus for transferring blocks of pixel data at the same time from the DRAM to the PDU, whereby the PDU can process the blocks of pixel data for subsequent display of processed pixel data.

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## EUROPEAN SEARCH REPORT

Application Number  
EP 95 10 7711

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	DE-A-36 28 286 (STÄRK J.)  * abstract * * column 1, line 56 - column 2, line 28 * * column 3, line 6 - line 41 * * column 4, line 7 - line 14 * * column 7, line 21 - line 49 * * figures 2,3,11,12 * ---	1 18,19, 32,33	G09G1/16 G09G5/36
A	NEC RESEARCH AND DEVELOPMENT, vol. 33, no. 4, TOKYO JP, pages 585-594, XP 000354897 FUJITA ET AL. 'Integrated memory array processor.' * the whole document * ---	1-4	
A	IEEE JOURNAL OF SOLID-STATE CIRCUITS, vol. 25, no. 1, NEW YORK US, pages 30-35, XP 000101845 HISAKAZU KOTANI ET AL. 'A 50 MHz 8 Mbit video RAM with a column direction drive sense amplifier.' * page 31, left column, line 15 - line 24 * * figure 2 * ---	2	TECHNICAL FIELDS SEARCHED (Int.Cl.6)  G09G G11C H03K H01L
A	EP-A-0 334 524 (DU PONT PIXEL SYSTEMS LTD.) * page 15, line 55 - page 16, line 4 * * abstract * ---	1	
Y	GB-A-2 208 344 (INTERNATIONAL COMPUTER LIMITED) * page 1, line 19 - line 35 * * page 3, line 29 - page 4, line 4 * * page 7, line 13 - page 9, line 16 * * figures 2,5 * --- -/--	18,19	
<del>The present search report has been drawn up for all claims</del>			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>18 April 1996</b>	Examiner <b>Farricella, L</b>
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- &amp; : member of the same patent family, corresponding document</p>			

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# EUROPEAN SEARCH REPORT

Application Number  
EP 95 10 7711

DOCUMENTS CONSIDERED TO BE RELEVANT				
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)	
A	US-A-4 691 295 (ERWIN ET AL.) * abstract *	18		
A	--- EP-A-0 165 441 (INTERNATIONAL BUSINESS MACHINES CO.) * abstract *	19		
A	--- EP-A-0 492 840 (NCR CORPORATION) * abstract * * column 7, line 11 - line 35 * * figures 1,7 *	22		
Y A	--- EP-A-0 474 366 (TEXAS INSTRUMENTS INC.) * column 1, line 24 - line 34 * * column 2, line 39 - column 3, line 3 * * column 7, line 42 - column 8, line 3 * * column 10, line 57 - column 11, line 48 * * figures 2-4 *	32,33 18,20,25		
A	--- US-A-5 170 154 (MANTOPOULOS) * column 2, line 34 - line 52 * * figure 2 *	18,36		TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	--- GB-A-2 217 066 (INTERNATIONAL COMPUTER LIMITED) * abstract *	20		
Y	--- EP-A-0 547 892 (SGS-THOMSON MICROELECTRONICS INC.) * column 5, line 32 - column 6, line 23 * * column 13, line 5 - line 13 * * column 13, line 46 - column 16, line 28 * * figures 1-5 *	17		
The present search report has been drawn up for all claims				
Place of search THE HAGUE		Date of completion of the search 18 April 1996	Examiner Farricella, L	
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document				

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# EUROPEAN SEARCH REPORT

Application Number  
EP 95 10 7711

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.CL6)
Y	EP-A-0 260 578 (INTERNATIONAL BUSINESS MACHINES CO.) * column 2, line 6 - line 25 * * column 4, line 1 - line 39 * * figure 1 *	17	
A	--- EP-A-0 383 080 (TOSHIBA K.K.) * column 5, line 50 - column 6, line 31 * * figure 1 *	17	
A	--- US-A-5 083 047 (HORIE ET AL.) * column 2, line 9 - line 19 * * column 7, line 49 - column 8, line 13 * * figure 7 * -----	17	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.CL6)
Place of search		Date of completion of the search	Examiner
THE HAGUE		18 April 1996	Farricella, L
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- &amp; : member of the same patent family, corresponding document</p>			

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### CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claims:
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

### LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions.

namely:

See Sheet 8.

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☒ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid.
- namely claims: 12, 13 10-27, 17, 32-38
- ☐ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims.
- namely claims:



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#### LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims 1-11, 14-16:  
Single chip display processor including pixel processor, DRAM for frame buffer and massively parallel bus. Sense amplifiers and pixel processors are suitably placed on the chip to allow wide bus. (Non unity a posteriori).
2. Claims 12,13:  
Single chip display processor including pixel processor, DRAM for frame buffer and massively parallel bus. Registers of pixel processor have a structure that allows power saving. (Non unity a posteriori).
3. Claims 18-27:  
Single chip display processor including pixel processor, DRAM for frame buffer and massively parallel bus. DRAM is organized in bit planes (Non unity a posteriori).
4. Claim 17:  
Structure of a DRAM including a dummy data bus. (Non unity a priori).
5. Claims 29-31:  
Single chip display processor including pixel processor, DRAM for frame buffer and RAM DAC. (Non unity a priori).
6. Claims 32-38:  
Method of displaying pixel data using a massively parallel bus. (Non unity a priori).